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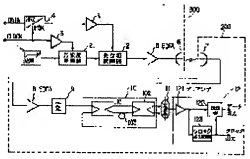
(54) OPTICAL COMMUNICATION SYSTEM AND OPTICAL TRANSMITTER THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an optical communication system and an optical transmistter which can improve the receiving sensitivity to increase the non-relay transmission range and also to miniaturize the optical antennas of both transmitter and receiver sides.

SOLUTION: The continuous beams which are outputted from a laser light source 1 are turned into the impulsive forms via the modulation of intensity undergone by the clock signal synchronous with the data signal and then inputted to an optical phase modulator 2. Meanwhile, the data signal is converted into a DPSK code by an encoder (NRZ/DPSK) 4 and applied to the modulator 2 as a drive signal. Thus, an optical signal of an impulsive form that undergone the phase modulation based on the data signal is generated. This optical signal is amplified by an EDFA 5 and radiated into a space through an optical antenna 6. The radiated optical signal is received an optical antenna 7, amplified and formed into a waveform. Then the phase change of the optical signal is converted into the intensity change by an optical interferer 10. The converted optical signal undergoes the photoelectric conversion and the data are reproduced by 8 receiving circuit 12.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the optical transmission system which transmits information through the lightwave signal emitted to space A code translation means to change into a binary synchro-differential phase shift keying sign the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The light source which carries out the generating output of the continuation light, and a light pulse generation means to generate a light pulse by carrying out intensity modulation of the output light of this light source based on said clock signal, The optical phase modulator which carries out the phase modulation of the light pulse which this light pulse generation means outputs, The optical phase modulator driving means which drives this optical phase modulator based on the output of said code translation means, An optical sending set equipped with the optical amplifier which amplifies the output of said optical phase modulator about predetermined reinforcement, and a lightwave signal output means to emit the output of this optical amplifier to space, A lightwave signal receiving means to receive the lightwave signal emitted by said lightwave signal output means, The optical interference machine which dichotomizes the lightwave signal received by this lightwave signal receiving means, joins together, and changes the phase change of said receiving lightwave signal into a change on the strength after delaying 1 bit of lightwave signals of one of the two, The optical transmission system characterized by providing an optical receiving set equipped with the optical/electrical converter which carries out photo electric conversion of the output of this optical interference machine, and the data playback means which carries out discernment playback of the data signal from the output of this optical/electrical converter.
[Claim 2] In the optical transmission system which transmits information through the lightwave signal emitted to space A code translation means to change into a binary synchro-differential phase shift keying sign the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The light source which carries out the generating output of the continuation light, and the optical phase modulator which carries out the phase modulation of the output light of this light source, The optical phase modulator driving means which drives this optical phase modulator based on the output of said code translation means, A light pulse generation means to generate a light pulse by carrying out intensity modulation of the output light of said optical phase modulator based on said clock signal, An optical sending set equipped with the optical amplifier which amplifies the output of this light pulse generation means about predetermined reinforcement, and a lightwave signal output means to emit this optical amplifier output to space, A lightwave signal receiving means to receive the lightwave signal emitted by said lightwave signal output means, The optical interference machine which dichotomizes the lightwave signal received by this lightwave signal receiving means, joins together, and changes the phase change of said receiving lightwave signal into a change on the strength after delaying 1 bit of lightwave signals of one of the two, The optical transmission system characterized by providing an optical receiving set equipped with the optical/electrical converter which carries out photo electric conversion of the output of this optical interference machine, and the data playback means which carries out discernment playback of the data

signal from the output of this optical/electrical converter.
[Claim 3] In the optical transmission system which transmits information through the lightwave signal emitted to space A code translation means to change into the synchro-differential phase shift keying sign of three values the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The 1st optical interference machine combined and outputted after making it change based on the driving signal which was able to give the phase of the light source which carries out the generating output of the continuation light, and the lightwave signal which dichotomized and branched the output light of this light source, The optical interference machine driving means which drives said 1st optical interference machine based on the output of said code translation means, An optical sending set equipped with the optical amplifier which amplifies the output of said optical interference machine about predetermined reinforcement, and a lightwave signal output means to emit the output of this optical amplifier to space, A lightwave signal receiving means to receive the lightwave signal emitted by said lightwave signal output means, The 2nd optical interference machine which dichotomizes the lightwave signal received by this lightwave signal receiving means, joins together, and changes the phase change of said receiving lightwave signal into a change on the strength after delaying 1 bit of lightwave signals of one of the two, The optical transmission system characterized by providing an optical receiving set equipped with the optical/electrical converter which carries out photo electric conversion of the output of this 2nd optical interference machine, and the data playback means which carries out discernment playback of the data signal from the output of this optical/electrical converter.
[Claim 4] It is the optical sending set used with the optical transmission system which transmits information through the lightwave signal emitted to space. A code translation means to change into a binary synchro-differential phase shift keying sign the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The light source which carries out the generating output of the continuation light, and a light pulse generation means to generate a light pulse by carrying out intensity modulation of the output light of this light source based on said clock signal, The optical phase modulator which carries out the phase modulation of the light pulse which this light pulse generation means outputs, The optical sending set characterized by having the optical phase modulator driving means which drives this optical phase modulator based on the output of said code translation means, the optical amplifier which amplifies the output of said optical phase modulator about predetermined reinforcement, and a lightwave signal output means to emit the output of this optical amplifier to space.
[Claim 5] It is the optical sending set used with the optical transmission system which transmits information through the lightwave signal emitted to space. A code translation means to change into a binary synchro-differential phase shift keying sign the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The light source which carries out the generating output of the continuation light, and the optical phase modulator which carries out the phase modulation of the output light of this light source, The optical phase modulator driving means which drives this optical phase modulator based on the output of said code translation means, A light pulse generation means to generate a light pulse by carrying out intensity modulation of the output light of said optical phase modulator based on said clock signal, The optical sending set characterized by having the optical amplifier which amplifies the output of this light pulse generation means about predetermined reinforcement, and a lightwave signal output means to emit the output of this optical amplifier to space.
[Claim 6] It is the optical sending set used with the optical transmission system which transmits information through the lightwave signal emitted to space. A code translation means to change into the synchro-differential phase shift keying sign of three values the data signal expressed with a predetermined sign based on the clock signal which carried out the bit synchronization to the data signal concerned, The optical interference machine combined and outputted after making it change based on the driving signal which was able to give the phase of the light source which carries out the generating output of the continuation light, and the lightwave signal which dichotomized and branched the output

light of this light source, The optical sending set characterized by providing the optical interference machine driving means which drives said optical interference machine based on the output of said code translation means, the optical amplifier which amplifies the output of said optical interference machine about predetermined reinforcement, and a lightwave signal output means to emit the output of this optical amplifier to space.
[Claim 7] Said optical interference machine is an optical sending set according to claim 6 characterized by being a Mach TSUENDA type light interference machine.
[Claim 8] Said optical amplifier is an optical sending set given in either of claims 4, 5, and 6 characterized by being erbium dope mold optical fiber amplifier.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical transmission system used for example, in the optical communication between satellites, and its optical sending set.
[0002]
[Description of the Prior Art] The optical transmission system in various environments is being developed with development of an optical-communication technique in recent years. The system which emits a direct lightwave signal to space, without minding an optical fiber, and transmits a lightwave signal for example, between satellites in such a situation is considered. The conventional configuration of this kind of optical transmission system is shown in drawing 11 .
[0003] The optical transmission system shown in drawing 11 consists of an optical sending set 100 and an optical receiving set 200. In the optical sending set 100, the continuation light (coherent light) outputted from a laser light source 1 is led to the input port of the optical phase modulator 2. The output of an encoder (NRZ/DPSK) 4 by which the gain adjustment was carried out with amplifier 3 is given to this optical phase modulator 2 as a driving signal. that from which this encoder (NRZ/DPSK) 4 changes into a DPSK (Differential Phase Shift Keying : synchro-differential phase shift keying) sign the data signal expressed by the NRZ code based on the clock signal which carried out the bit synchronization to this data signal -- it is -- thereby -- the output light of a laser light source 1 -- this -- it is carried out. After the lightwave signal by which the phase modulation was carried out here is amplified with the erbium dope optical fiber amplifier (it omits Following EDFA) 5, it is emitted to space from the optical antenna 6.
[0004] After this emitted lightwave signal spreads space, it is received by the optical antenna 7 of the optical receiving set 200. This received feeble lightwave signal is amplified by EDFA8, and after an optical noise is attenuated with the optical band pass filter 9 of a narrow-band, it is led to the optical interference machine 10. This optical interference machine 10 is equipped with the optical coupling machine 101,102 and the 1-bit light delay machine 103, after it dichotomizes the inputted lightwave signal with the optical coupling vessel 101, it delays lightwave signal of one of the two by 1 bit with the 1-bit light delay vessel 103, and it changes the phase change of an input lightwave signal into a change on the strength by joining together again with the optical coupling vessel 102. Photo electric conversion of the output of this optical interference machine 10 is carried out with an optical/electrical converter 11, and it is led to a receiving circuit 12.
[0005] A receiving circuit 12 is equipped with pre amplifier 121, a discrimination circuit 122, and the clock extract circuit 123, and the output of an optical/electrical converter 11 dichotomizes, after being amplified by pre amplifier 121, and it is given to a discrimination circuit 122 and the clock extract circuit 123, respectively. In the clock extract circuit 123, a clock signal is extracted from an input signal, and this clock signal is also given to a discrimination circuit 122 while it is outputted outside. And discernment playback of the data signal is carried out by the discrimination circuit 122, and received data are outputted outside.

[0006] Actuation of the above-mentioned optical transmission system is explained in more detail using drawing 12 . Here, it explains, assuming that "0100110" is transmitted as a data signal. A data signal (a) is inputted into an encoder (NRZ/DPSK) 4 with a clock signal (b), and is changed into the DPSK sign (c) which synchronized with the clock signal. This DPSK sign is a sign with the property in which it is reversed whenever "1" appears in input data, and the optical phase modulator 2 is driven with this DPSK sign. Consequently, the continuation light (d) from a laser light source 1 is modulated by the lightwave signal which has two phases corresponding to a DPSK sign as shown in (e). Here, the time of 0 and reversal is described for the time of phase noninverting as pi. After this modulated lightwave signal (e) is amplified by EDFA5, it is emitted to space from the optical antenna 6.
[0007] It is received by the optical antenna 7 of the optical receiving set 200, and this emitted lightwave signal is amplified by EDFA8, and is led to the optical band pass filter 9. After a noise component is attenuated here, a receiving lightwave signal is inputted into the optical interference machine 10.
[0008] Here, the output lightwave signal of the 1-bit light delay machine 103 of the optical interference machine 10 is shown in (f) of drawing 12 . If the lightwave signal of wave (e) and (f) is combined with the optical coupling vessel 102, in reverse, i.e., "pi", "0" or "0", and "pi", the phase of both waves will negate each other. On the other hand, when the phase of both waves is the "pi" inphase, comrades or "0", it suits in slight strength mutually. [i.e.,] For this reason, the wave by which intensity modulation was carried out as shown in (g) of drawing 12 in the output stage of the optical interference machine 10 is acquired. With an optical/electrical converter 11, this lightwave signal by which intensity modulation was carried out is changed into an electrical signal, clock playback and discernment playback are carried out in a receiving circuit 12, and the original data signal is reproduced. Furthermore, if this wave is reversed, the original sign train (h) will be acquired.
[0009] It is known for the above-mentioned conventional optical transmission system that a receiving property [high sensitivity about 3dB] will be acquired by the optic fiber communication of a ground system as compared with the IM-DD (intensity modulation and direct detection) method usually used.
[0010] A communication range is expandable by amplifying the lightwave signal which prepared the optical repeater in the middle of the transmission line, and deteriorated in it in the place when an optical fiber was used as communication media like the optical transmission system for example, in a ground system. However, if it is in the system which emits a direct lightwave signal to space as mentioned above, and transmits a lightwave signal, an optical repeater cannot be prepared in the middle of a transmission line. For this reason, in order to expand a transmission distance more, it is required to raise the sensibility of a system, and it waits for development of the optical transmission system of high sensitivity further. If it is in the optical transmission system between satellites especially, a merit is large at the point of being able to make small size of the optical antenna carried in a satellite by raising the sensibility of a system, and attaining lightweight-ization of a satellite.
[0011]
[Problem(s) to be Solved by the Invention] If it is in the optical transmission system which emits a direct lightwave signal to space and transmits a lightwave signal as described above, it waits for development of the optical transmission system which raised receiving sensibility further.
[0012] While this invention was made according to the above-mentioned situation, the purpose raises receiving sensibility and this aims at expansion of the transmission distance non-acted as intermediary, it is in offering the optical transmission system which makes it possible to attain the miniaturization of the optical antenna of a transmitting side and a receiving side, and its optical sending set.
[0013]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the optical transmission system of this invention changes into a binary synchro-differential phase shift keying sign the data signal which forms a code translation means in an optical sending set, for example, is expressed with predetermined signs, such as an NRZ code, based on the clock signal which carried out the bit synchronization to the data signal concerned in the optical transmission system which transmits information through the lightwave signal emitted to space. And after considering as a light pulse by carrying out intensity modulation of the continuation light which the light source outputs based on said

said clock signal and modulating this light pulse with 0 and two phases of pi based on the output of said code translation means, it amplifies about reinforcement predetermined with an optical amplifier, and emanates to space.

[0014] After dichotomizing after amplifying the lightwave signal emitted to this space and removing a noise, and delaying 1 bit of lightwave signals of one of the two in an optical receiving set, both lightwave signals are combined and the phase change of said receiving lightwave signal is changed into a change on the strength. This lightwave signal is changed into an electrical signal with an optical/electrical converter, and discernment playback of the data signal is carried out by the data playback means.

[0015] Thus, when constituted, the lightwave signal by which the phase modulation was carried out according to the data signal will be emitted in pulse. For this reason, when average transmitting power can be lowered conventionally and the same transmitting power compares, receiving sensibility can be raised conventionally. Moreover, the peak power of a transmitting lightwave signal can be conventionally raised by using for example, erbium dope mold optical fiber amplifier for an optical amplifier. This becomes possible to extend a transmission distance.

[0016] Moreover, after carrying out the phase modulation of the continuation light, intensity modulation is carried out and you may make it generate a light pulse in an optical transmitter. Moreover, a data signal is changed into the synchro-differential phase shift keying sign of three values, and you may make it generate the light pulse by which the phase modulation was directly carried out from the continuation light which the light source outputs because this drives a Mach TSUENDA type light interference machine, for example. By doing in this way, components mark can be reduced and lightweight-ization at the time of carrying an optical transmission system in a satellite can be attained.

[0017]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

(1st operation gestalt) Drawing 1 is drawing showing the configuration of the optical transmission system concerning the 1st operation gestalt of this invention. In addition, in drawing 1 , the same sign is attached and shown in the same part as drawing 11 , and detailed explanation is omitted.

[0018] The optical transmission system shown in drawing 1 consists of an optical sending set 300 and an optical receiving set 200. Among these, the optical sending set 300 is equipped with an optical intensity modulator 21 and the amplifier 31 which is the drive circuit.

[0019] That is, in the optical sending set 300, the output light of a laser light source 1 is led to the input port of an optical intensity modulator 21. The clock signal which carried out the bit synchronization is given to the data signal as a driving signal through amplifier 31, and, thereby, the lightwave signal of the shape of a pulse which synchronized with the clock signal is outputted to this optical intensity modulator 21 from an optical intensity modulator 21.

[0020] The output of this optical intensity modulator 21 is led to the optical phase modulator 2. The output of an encoder (NRZ/DPSK) 4 is given to this optical phase modulator 2 as a driving signal through amplifier 3, and, for this reason, the lightwave signal of the shape of a pulse by which the phase modulation was carried out according to the DPSK sign is outputted to it from the optical phase modulator 2. And the output of the optical phase modulator 2 is amplified by EDFA, and is emitted to space from the optical antenna 6.

[0021] It explains in more detail using drawing 2 . A data signal (a) is inputted into an encoder (NRZ/DPSK) 4 with a clock signal (b), and is changed into the DPSK sign (c) which synchronized with the clock signal. Level adjustment of this data signal by which DPSK coding was carried out is carried out with an amplifier 3, and it is given to the optical phase modulator 2 as a driving signal.

[0022] Moreover, level adjustment of the clock signal (b) is inputted and carried out also to an amplifier 31, and it is given to an optical intensity modulator 21 as a driving signal. Consequently, intensity modulation of the continuation light which a laser light source 1 outputs is carried out to the lightwave signal of the shape of a pulse which synchronized with the clock signal as shown in (d) of drawing 2 . This on-the-strength strange modulated light is inputted into the optical phase modulator 2, and as a

result, from the optical phase modulator 2, as shown in (e) of drawing 2 , the pulsed light which a phase reverses according to a DPSK sign is outputted. Here, corresponding to "L" of a DPSK sign, and "H", the phase of pulsed light is described as "0" and "pi." After this pulsed light (e) by which the phase modulation was carried out is amplified by EDFA5, it is emitted to space from the optical antenna 6. Here, EDFA5 has the property in which the saturation power is restricted by not peak power but the average power of an input lightwave signal. That is, in an output side, higher peak power can be obtained by making into the shape of a pulse the lightwave signal inputted into EDFA5, and reducing the duty.

[0023] It is received by the optical antenna 7 of the optical receiving set 200, magnification and control of a noise are made with EDFA8 and the optical band pass filter 9, and this emitted lightwave signal is inputted into the optical interference machine 10. The inputted lightwave signal dichotomizes with the optical coupling vessel 101, and lightwave signal of one of the two is delayed by this optical interference machine 10 by 1 bit with the 1-bit light delay vessel 103. This delayed wave is shown in (f) of drawing 2 . It is again combined with the branched lightwave signal and the branched optical coupling machine 102 of another side, and this wave (f) is outputted as on-the-strength strange modulated light shown in wave (g). After this on-the-strength strange modulated light (g) is changed into an electrical signal with an optical/electrical converter 11, it is inputted into a receiving circuit 12, clock playback and discernment playback are carried out, and the original data are reproduced by reversing this wave. In addition, this reversal actuation is performed by preparing the inverter which is not illustrated in a receiving circuit 12. This output wave is shown in (h).

[0024] In this way, with this operation gestalt, intensity modulation of the continuation light which a laser light source 1 outputs is carried out with the clock signal which carried out the bit synchronization to the data signal, it is made into the shape of a pulse, and is inputted into the optical phase modulator 2. Moreover, a data signal is changed into a DPSK sign with an encoder (NRZ/DPSK) 4, and it gives the optical phase modulator 2 by making this into a driving signal. The lightwave signal of the shape of a pulse by which the phase modulation was carried out by this based on the data signal is generated, this lightwave signal is amplified by EDFA5, and it emanates to space from the optical antenna 6. The optical antenna 7 receives this emitted lightwave signal, and magnification and after carrying out corrugating, the phase change of a lightwave signal is changed into a change on the strength with the optical interference vessel 10. After carrying out photo electric conversion of this lightwave signal, data playback is carried out in a receiving circuit 12.

[0025] Thereby, the optical transmission through the space between the optical sending set 300 and the optical receiving set 200 becomes possible. Moreover, since the transmission lightwave signal is made into the shape of a pulse, when the same transmitting power compares, receiving sensibility can be raised conventionally. Furthermore, the peak power of output light can be raised more by carrying out the magnification output of the lightwave signal with erbium dope mold optical fiber amplifier in the optical sending set 300, and it enables this to extend a transmission distance.

[0026] (2nd operation gestalt) Drawing 3 is drawing showing the configuration of the optical transmission system concerning the 2nd operation gestalt of this invention. In addition, also in drawing 3 , the same sign is attached and shown in the same part as drawing 11 , and detailed explanation is omitted.

[0027] The optical transmission system shown in drawing 3 consists of an optical sending set 400 and an optical receiving set 200. Among these, the optical sending set 400 is equipped with 3 value coder 41 and the Mach TSUENDA type light interference machine 22 (it is written as MZ type light interference machine 22 below).

[0028] That is, in the optical sending set 400, the output light of a laser light source 1 is led to EDFA through MZ type light interference machine 22, is amplified and is emitted to space from the optical antenna 6.

[0029] The output of 3 value coder 41 is given to this MZ type light interference machine 22 as a driving signal through amplifier 3. Furthermore, the output of an encoder (NRZ/DPSK) 4 is given to this 3 value coder 41 with the clock signal.

[0030] The configuration of an encoder (NRZ/DPSK) 4 and 3 value coder 41 is shown in drawing 4 . A binary DPSK sign is obtained in an encoder (NRZ/DPSK) 4 being equipped with the AND gate 401 and T mold flip-flop 402, inputting into the AND gate 401 the data signal expressed by the NRZ code with a clock signal, and inputting the output into T mold flip-flop 402. 3 value coder 41 is equipped with the AND gate 403, the NOT gate 404, the OR gate 405, and the electrical-potential-difference adder 406. The binary DPSK sign which an encoder (NRZ/DPSK) 4 outputs dichotomizes, and is given to the AND gate 403 and the OR gate 405. Moreover, a clock signal also dichotomizes, another side is reversed by the AND gate 403 in the NOT gate 404, and one of the two is given to it in the OR gate 405. And from 3 value coder 41, the DPSK sign of three values which synchronized with the clock signal is outputted by adding the output of the AND gate 403 and the OR gate 405 with the electrical-potential-difference adder 406. On-the-strength adjustment is carried out according to the property of MZ type light interference machine 22 mentioned later, and the DPSK sign of these three values is given to MZ type light interference machine 22 as a driving signal. This driving signal takes three values, 3/2Vpi, Vpi, and 1/2Vpi, as shown in drawing 5 .

[0031] The configuration of MZ type light interference machine 22 is shown in drawing 6 . This MZ type light interference machine 22 is LiNbO3. The permeability and phase of an input lightwave signal are controlled by consisting of a crystal (lithium niobate), dichotomizing, leading the lightwave signal inputted to optical waveguides l1 and l2, respectively, changing the refractive-index difference of such optical waveguides l1 and l2 by driver voltage, and joining together again.

[0032] The input-output behavioral characteristics (applied-voltage-permeability) of this MZ type light interference machine 22 are shown in drawing 7 . The phase contrast of the lightwave signal which branched when driver voltage was increased changes continuously, and permeability changes in sine with this. If driver voltage from which phase contrast is set to pi and permeability sets it 0% is set to Vpi, the optical output from which phase contrast pi [rad] Differs [driver voltage / permeability] at 50% in respect of 1/2Vpi, and 3/2Vpi will be obtained. That is, the light pulse by which the phase modulation was carried out directly can be obtained by giving the electrical potential difference which takes the value of 1/2Vpi, Vpi, and 3/2Vpi as a driving signal to MZ type light interference machine 22.

[0033] The signal wave form in this operation gestalt is shown in drawing 8 . A data signal (a) and a clock signal (b) are first inputted into an encoder (NRZ/DPSK) 4, are changed into a binary DPSK sign, are inputted into 3 value coder 41 with a clock signal, and turn into a DPSK sign (c) of three values. Level adjustment of it is carried out so that the DPSK sign (c) of these three values may take the value of 1/2Vpi, Vpi, and 3/2Vpi with an amplifier 3, and it is given to MZ type light interference machine 22 as a driving signal. Then, this MZ type light interference machine 22 carries out the generating output of the light pulse by which the phase modulation was carried out as directly shown in (d) from the continuation light which a laser light source 1 outputs. This output light is amplified by EDFA5, and is emitted towards space from the optical antenna 6. The lightwave signal which, on the other hand, followed the same process as the operation gestalt of the above 1st in the optical receiving set 200, and was received dichotomizes, 1 bit of lightwave signals of one of the two is delayed ((e) of drawing 8), they are combined, and it becomes on-the-strength strange modulated light of (f), after photo electric conversion is carried out, it is reversed, and the original data (g) are reproduced.

[0034] In this way, with this operation gestalt, a data signal is made into the DPSK sign of three values based on a clock signal, level adjustment of this is carried out and it is given to MZ type light interference machine 22 in order to take the value of 1/2Vpi, Vpi, and 3/2Vpi. The light pulse signal by which the phase modulation was directly carried out to binary can be acquired from the continuation light which a laser light source 1 outputs by this. For this reason, the optical transmission system which simplified the configuration further can be offered, for example, in case it is used carrying in a satellite, lightweight-izing of a system and a miniaturization can be attained.

[0035] In addition, this invention is not limited to each above-mentioned operation gestalt. For example, although it was made to carry out a phase modulation with the 1st operation gestalt after carrying out intensity modulation of the output light of a laser light source 1, this sequence is arbitrary, and good, for example, may be made to carry out intensity modulation of the lightwave signal by which the phase

modulation was carried out. That is, after carrying out the phase modulation of the output light of a laser light source 1 with the optical phase modulator 2, intensity modulation is carried out and you may make it output with an optical intensity modulator 21. The example of the structure of a system carried out in this way is shown in drawing 9 .

[0036] That is, the optical sending set shown in 500 of drawing 9 inputted the output light of a laser light source 1 into the optical phase modulator 2, the phase modulation of it was carried out to binary, it inputted the output into the optical intensity modulator 21, and has obtained pulse-like output light. Here, a clock signal is given to the optical phase modulator 2 for a binary DPSK sign as a driving signal at an optical intensity modulator 21, respectively. Thus, even if constituted, the same effectiveness as the operation gestalt of the above 1st is acquired.

[0037] Moreover, although each above-mentioned operation gestalt explained as an example the case where one-way communication was performed, of course, it is also possible to apply this invention to a two-way communication system. The example of the structure of a system carried out in this way is shown in drawing 10 . That is, it is possible to apply this invention to the wavelength multisystem which prepares two systems which connected the optical receiving set 200 and the optical sending set 300 (or 400,500) through the optical coupler 50, and communicates by the going-up side and light wave length f1 and f2 who gets down, considers as a side and is different, respectively.

[0038] Moreover, although each above-mentioned operation gestalt explained supposing the case where carry an optical transmission system in a satellite and it communicates through space between satellites, an optical transmission system is built on the ground, and it may be made to communicate between ground-satellites. Or it is possible to apply this invention as an optical transmission system which does not mind an optical fiber in the ground. In addition, deformation implementation various in the range which does not deviate from the summary of this invention is possible.

[0039]

[Effect of the Invention] Since the lightwave signal which carried out the phase modulation is made into the shape of a pulse and it was made to output it according to this invention as explained in full detail above, when average transmitting power can be lowered conventionally and the same transmitting power compares, receiving sensibility can be raised conventionally. Moreover, the peak power of a transmitting lightwave signal can be conventionally raised now by using for example, erbium dope mold optical fiber amplifier for an optical amplifier, and it becomes possible to extend a transmission distance.

[0040] While receiving sensibility is raised and this aims at expansion of the transmission distance non-acted as intermediary by the above, it becomes possible to offer the optical transmission system which makes it possible to attain the miniaturization of the optical antenna of a transmitting side and a receiving side, and its optical sending set.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration of the optical transmission system concerning the 1st operation gestalt of this invention.
[Drawing 2] The wave form chart for explaining actuation of the optical transmission system concerning the 1st operation gestalt of this invention.
[Drawing 3] The block diagram showing the configuration of the optical transmission system concerning the 2nd operation gestalt of this invention.
[Drawing 4] The logic block diagram showing the example of a configuration of an encoder (NRZ/DPSK) 4 and 3 value coder 41.
[Drawing 5] The wave form chart showing the DPSK sign as a driving signal of MZ type light interference machine 22.
[Drawing 6] The conceptual diagram showing the configuration of MZ type light interference machine 22.
[Drawing 7] The property Fig. showing the input-output behavioral characteristics of MZ type light interference machine 22.
[Drawing 8] The wave form chart for explaining actuation of the optical transmission system concerning the 2nd operation gestalt of this invention.
[Drawing 9] The block diagram showing other examples of the operation gestalt of this invention.
[Drawing 10] The conceptual diagram showing the example of application over the two-way communication system of this invention.
[Drawing 11] The block diagram showing the configuration of the conventional optical transmission system.
[Drawing 12] The wave form chart for explaining actuation of the conventional optical transmission system.
[Description of Notations]
100,300,400,500 -- Optical sending set
200 -- Optical receiving set
1 -- Laser light source
2 -- Optical phase modulator
3 -- Amplifier
4 -- Encoder (NRZ/DPSK)
5 Eight -- Erbium dope optical fiber amplifier (EDFA)
6 7 -- Optical antenna
9 -- Optical band pass filter
10 -- Optical interference machine
101,102 -- Optical coupling machine
103--1-bit light delay machine
11 -- Optical/electrical converter

12 -- Receiving circuit
121 -- Pre amplifier
122 -- Discrimination circuit
123 -- Clock extract circuit
21 -- Optical intensity modulator
31 -- Amplifier
41 -- 3 value coder
401,403 -- AND gate
402 -- T mold flip-flop
404 -- NOT gate
405 -- OR gate
406 -- Electrical-potential-difference adder
22 -- Mach TSUENDA type light interference machine (MZ type light interference machine)
50 -- Optical coupler
60 -- Optical antenna

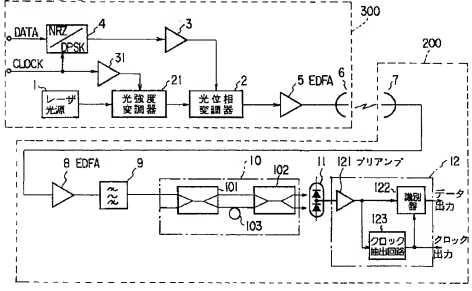
[Translation done.]

* NOTICES *

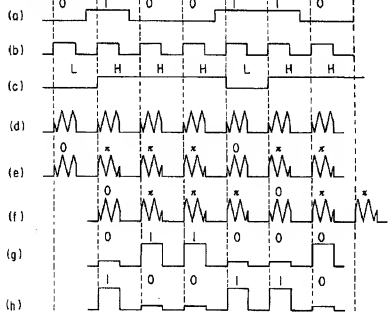
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

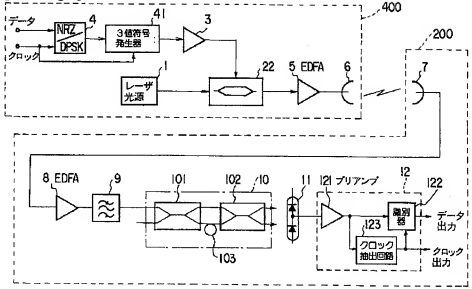
[Drawing 1]



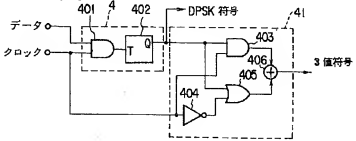
[Drawing 2]



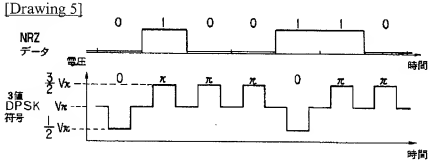
[Drawing 3]



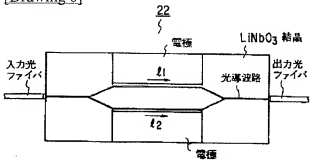
[Drawing 4]



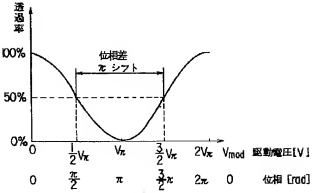
[Drawing 5]



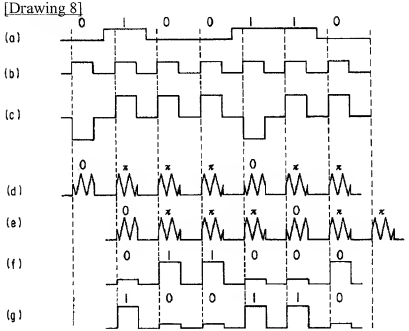
[Drawing 6]



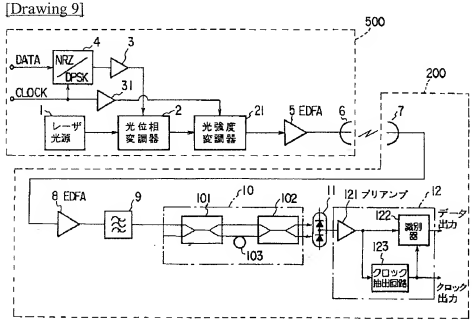
[Drawing 7]



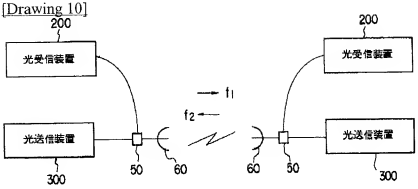
[Drawing 8]



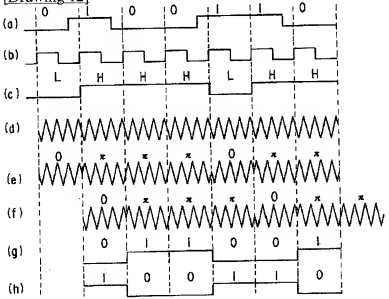
[Drawing 9]



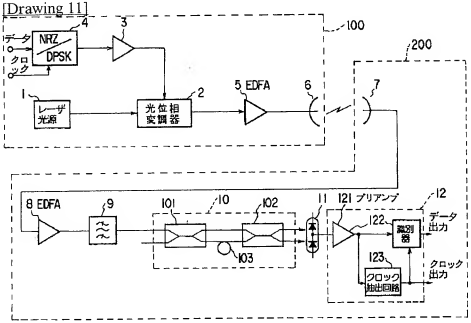
[Drawing 10]



[Drawing 12]



[Drawing 11]



[Translation done.]